ARKIV FÖR FYSIK Band 11 nr 35

Communicated 14 November 1956 by Erik Hulthén

# Some infrared bands of vanadium oxide

By Albin Lagerqvist and Lars-Erik Selin

With 1 figure in the text

Two band-systems have been attributed to the spectrum of V0, one in the visible region (Mahanti, 1935) and one in the near infrared (Keenan and Schroeder, 1952). The vibrational constants for the lower states of these systems are almost equal, indicating that the lower state is in common. This state is probably the ground state (Lagerqvist and Huldt, 1954). With a spectrograph of small dispersion and a PbS cell Kleman and Liljeqvist (1935) investigated the flame spectrum of vanadium chloride and found intense emission in the region 1.0 $\mu$ to 1.5 $\mu$.

The infrared bands from a vanadium arc have now been photographed up to 11 300 Å in two plane grating spectrographs (reciprocal dispersion 20 Å/mm and 3.8 Å/mm). Eastman Kodak M and Z plates were used. The figure shows reproductions of the bands. The 0,2 sequence of Keenan's system is clearly visible. It is, however, very difficult to measure the heads due to the number of lines in the background. The most striking feature of the spectrum is, however, the presence of red-shaded bands at about 10 470 Å. They probably belong to a system of V0 not known hitherto. Some heads are very easily detectable. The measurements are given in Table 1.

*Table 1.* Measurements of the heads of some infrared V0 bands.

| Intensity | Wavelength in Å | Wavenumber in cm$^{-1}$ |
|---|---|---|
| 3 | 10 462.6 | 9 557.8 |
| 3 | 82.2 | 40.0 |
| 1* | 89.7 | 33.2 |
| 2 | 509.2 | 15.5 |
| 2 | 30.0 | 496.7 |
| 2* | 47.8 | 80.6 |
| 2* | 64.7 | 65.5 |

* Doubtful.

As we have been unable to photograph the V0 spectrum above 11 300 Å, not very much can be said about this new system. Between 9530 Å and 9590 Å some rather diffuse heads are present. They probably form the next sequence to shorter wavelengths. Kleman's and Liljeqvist's diagram suggests that the 0,0 band must be situ-

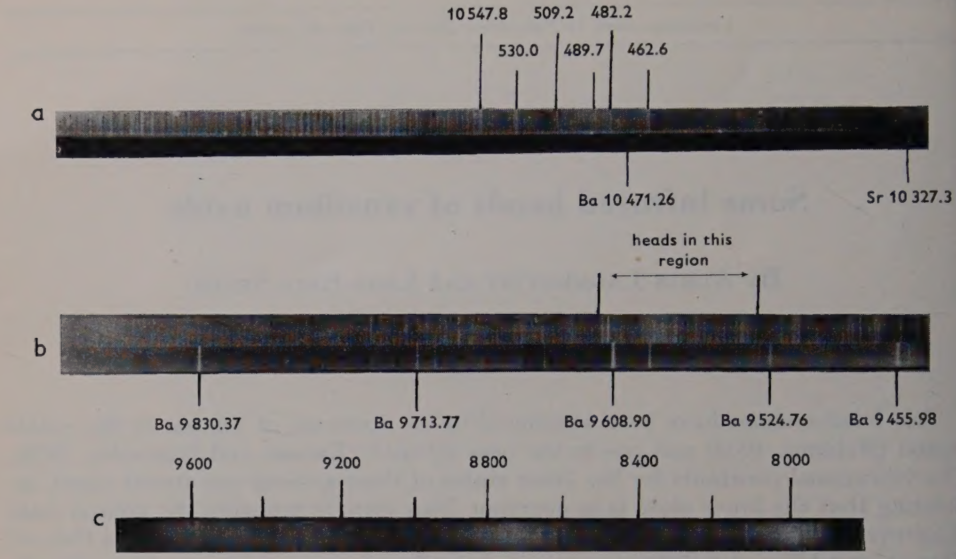

Fig. 1. Reproductions of the infrared V0 spectrum. a) and b) from the grating of the reciprocal dispersion 3.8 Å/mm, c) from that one with the dispersion 20 Å/mm.

ated to longer wavelengths. The high intensity of the new system makes it seem very likely that it corresponds to a transition from an excited state to the ground state of V0. Thus all the three V0 systems now known have the same lower state, which seems to be the normal state of the molecule.

*Physics Department, University of Stockholm, October 1956.*

*Note added in proof.*—The heads given in Table 1 are found in stellar absorption bands in R LeO (M 8e) and R Cas (M 7e) by A. McKellar (private communication by P. C. Keenan).

## REFERENCES

Keenan, P. C., and Schroeder, L. W., 1952, Astrophys. J. *115*, 82.
Kleman B. and Liljeqvist, B., 1955, Arkiv för Fysik, *9*, 377.
Lagerqvist, A. and Huldt, L., 1954, Arkiv för Fysik, *8*, 427.
Mahanti, P. C., 1935, Proc. Phys. Soc., *47*, 433.

Tryckt den 2 februari 1957

Uppsala 1957. Almqvist & Wiksells Boktryckeri AB